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GERMAN AIR FORCE SCALE OF EFFORT IN 1943

A statistical review of GAF scale of effort in 1943, illustrating the nature and extent of the policies of conservation adopted.

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SUMMARY AND CONCLUSIONS

1. The importance attached to defense against the growing weight of Allied strategic bombing, and the effort to prepare for a Western invasion combined to keep German Air Force scale of effort in 1943 at a comparatively low and declining level.

2. Defense against strategic bombing necessarily entails a lower utilization of available strength than does almost any other type of air force activity. Fighters must be spread widely to meet attacks on whatever part of the homeland the bombers may choose to invade, and not all of the defensive strength is therefore called upon on any given day, while the number of days of strategic bombing per month is relatively low. Although this permits high serviceability, and peak effort on any given day, the number of days of operation per month remains low.

3. Necessary specialization as between night and day fighters likewise increases the number of fighters that must be present to repel the double-barrelled Allied bombing offensive, and keeps the rate of utilization of defensive fighters at a low level.

4. In addition to the fact that the nature of the major GAF activity in 1943 compelled a low rate of utilization of strength, German conservation policies seem to have lowered the rate of use still further. The Luftwaffe obviously realized that the demands to be made on it in 1944 will be even greater than the 1943 demands. Not only will the growing weight of strategic bombing impose increasing demands upon German air defenses, but

the unmistakeable preparations for a Western invasion in 1944 called for the building up of the very maximum of available strength. In the face of this prospect of increased future requirements, production of fighters had been seriously reduced in the second half of the year by bombing attacks, and the plans for expanded fighter production in 1944 had been blasted. As a result, if strength were to be increased or even maintained, wastage, and therefore activity, had to be reduced. Therefore, defensive fighter effort revealed a growing, although selective, policy of conservation and caution. Maximum resistance continued to be offered to Allied attacks on deep strategic targets, but less and less resistance has been offered to attacks on targets in the occupied countries, and Allied fighter sweeps are almost unopposed. Combat for combat's sake is no longer attractive; clearly the war will not be won by mere shooting down of Allied fighters, while the war may be lost if German fighters are expended in enterprises of less than top priority. Likewise, bomber effort in 1943 was relatively conservative, and toward the end of the year, a substantial reserve was being accumulated in Central Germany.

5. Because of the defensive role of the GAF in the West, German fighter activity varied largely in correlation with Allied bombing activity.

6. Commitment of greater air strength to the Mediterranean Theater in 1943 might have substantially changed the nature of

results in that theater, although at the cost of many German planes. The commitment was never made, and what planes were sent to the Mediterranean were used in an essentially cautious fashion. In the latter half of the year advanced air bases were abandoned before they needed to have been, and only sporadic attempts were made to disrupt Allied shipping and the concentrations preceding amphibious operations.

7. Only in Russia did really intensive use appear to be made of the available planes, for this, too, is a front of crucial significance.

8. But the allocation of almost the entire increment of strength in 1943 to the West, and the character of the increment - i.e., almost entirely of fighters - indicate clearly enough the German scale of priorities.

GERMAN AIR FORCE SCALE OF EFFORT IN 1943

I. FACTORS AFFECTING SCALE OF EFFORT

A. Meaning and Significance of Scale of Effort

The military capabilities of a belligerent are frequently discussed in terms of numerical strength - so many divisions, guns, tanks, or planes. Mere existence of numerical strength, however, does not win battles, as is illustrated by the Italian fleet, or for that matter by the entire Italian war effort. A better measure of fighting value is the actual operative effort that has been or will be thrown into battle. Numerical strength must therefore, where possible, be translated into scale of effort.

The scale of effort of an air force is ordinarily measured in terms of the sortie rate - number of sorties flown in a given time-unit. Although other measures of scale of effort might be better in the case of individual aircraft types - e.g., the bomb tonnage dropped, or the number of enemy planes destroyed - measurement in terms of sorties has the advantage of being a simple, unequivocal measure, applicable to all types of aircraft.

However, the scale of effort of an air force, measured in terms of sorties, needs to be interpreted in terms of other measures, if its full significance is to be appreciated. One of the best of these additional measures is the ratio of its effort, measured in sorties, to the available strength. Thus, 200 sorties per day by a force of 400 planes represents an intensity of use much greater than 200 sorties per day by a force of 1,000 planes.

Another measure of intensity of effort, which must, however, be employed with caution, is the ratio of wastage to strength. This measure may reveal qualitative changes in the intensity of effort not revealed by the ratio of sorties to strength.

Still another measure of the significance of the scale of effort of an air force is the ratio of its effort to the effort of the opposing force. A change in this ratio indicates an actual or anticipated alteration of the relative strength of the opposing forces, necessitating or inducing a change in tactics by one or both, and is therefore of vital significance in assessing the tide of battle.

In this paper all of these measures will be used, where possible, to indicate the significance as well as the magnitude of the German Air Force scale of effort in 1943.

B. Determinants of Scale of Effort

The factors affecting the scale of effort of an air force are many. The available strength is, of course, the most important long-run determinant of scale of effort. Available strength sets a limit on the number of sorties that can be flown. A somewhat lower limit is imposed by the fact that all planes are not at all times in serviceable condition. The degree of serviceability, which in turn depends on the effectiveness and availability of crews, supplies, and repair facilities, and on the intensity of use of the force, thus is another factor determining scale of effort.

A second group of limiting factors is of another nature, relating to the type of plane and the nature of the combat operations. A given strength in night bombers, for example, can be expected to put forth a greater scale of effort within any given period of time than an equal number of daylight precision bombers, for the latter are more dependent on weather conditions than the former. Likewise, aircraft engaged on a front whose activity consists largely of ground operations, will normally fly a higher number of sorties per plane than those on a front where no ground forces are engaged, but where strategic bombing operations are in progress; and a front where both types of operations are proceeding may see a still higher number of sorties per plane. Strategic bombing operations are normally spasmodic in nature, and although this permits high plane serviceability and crew efficiency, and enables all available offensive or defensive strength to be engaged during such operations, the number of sorties per plane per week or month is typically lower than where the force is engaged almost daily in support of, or in conjunction with, ground operations. Whether the air force and/or its related ground forces are on the defensive or offensive will also normally affect its scale of effort. In the short run, defensive air activity ordinarily varies closely with the offensive activity of the opposing force, so that the defensive scale of effort on any given day or week will largely be determined by the scale of offensive operations of the enemy.

Finally, scale of effort is affected by the policies of conservation or all-out effort determined by the authorities responsible for its operations. Some degree of conservation of effort is almost always present - planes and crews are rarely considered to be completely expendable.[1] But conservation may be of several kinds and degrees. Conservation, for instance, may take the form of keeping more planes than necessary in a central reserve, or in storage depots at or just behind the frontline. Or it can take the form of regular, but less than full utilization of all available equipment; or it can be selective conservation - full utilization of equipment for certain purposes or at certain times, but less than full use for other pruposes or at other times. Likewise, conservation policies may merely limit the number of sorties per plane; or they may also limit the intensity of aggressiveness of the effort put forth. For example, the GAF has two grades of torpedo attack - "Beschränkter Einsatz" (restricted attack), which implies that the attack may be broken off if the defenses are too strong; and "Voller" or "Japanischer Einsatz" (full or Japanese attack), which must be pressed home at all costs. Defensive fighters, likewise, may be instructed to stop a bomber formation at whatever cost, or merely to harry the force and pick

1. It appears that original GAF policies (1939 and before) made planes and crews completely expendable - all based, of course, on the assumption of short, whirlwind campaigns, during which previously accumulated strength would be quickly expended.

off the stragglers. A conservation policy which affects the tactical intensity of use will not be fully revealed by a ratio of sorties to strength, although it may be revealed by the ratio of wastage to strength.[1]

As will be seen from the following sections, German Air Force policy in 1943 has exhibited various of these kinds and degrees of conservation.

II. GAF SCALE OF EFFORT IN 1943

A. The Western Front

The function of the Luftwaffe on the Western Front is to defend Germany against Allied strategic bombing, and to be ready to strike heavily against an invading ground force. Over 80 percent of GAF operations on this front in 1943 consisted of defensive fighter sorties. Bomber activity was limited to small-scale anti-shipping operations and nuisance attacks on English cities. In the entire year only 1985 long tons were dropped on England, a figure often exceeded in a single night by the RAF. Shipping reconnaissance, principally in aid of submarines, continued, though on a minor absolute scale relative to fighter activity.

1. Obviously, the ratio of wastage to strength depends not only on the number of sorties flown and the degree of aggressiveness of the fighting unit, but also on the relative skills, functions, and qualities of equipment of the opposing forces. But for any given front and any given type of aircraft engaged and type of operations performed, changes in the ratio of wastage to strength are likely to reflect chiefly the intensity of the effort put forth. The fact that changes in this ratio may also reflect changes in the relative qualities of equipment, relative skills of the crews, and other changes in combat conditions must be borne in mind, and requires that this ratio be interpreted with caution.

The long-run policy underlying German opposition in the West is conservation of aircraft for defense against invasion. Inititial establishment (IE) strength on this front was built up from 1,100 in January 1943 to 2,100 in 1944. Thus, nearly the entire increase in total German IE strength (1,100 planes in all) was allocated to the West, nearly doubling the strength in that theater. Only small use of this strength has been made, however, and that is the principal reason that the increase has been possible.

This is indicated in Charts I and II which show the daily average number of sorties per week and per month on the Western Front, for all types and for fighters alone. It will be noted that the average daily number of sorties was highest in August and September, with a peak monthly average in August of 240 total sorties per day, of which 190 were fighter sorties. Peak weekly averages were achieved in the week ending 22 August, when an average of 350 total sorties per day was recorded, including 300 fighter sorties.[1] A rather striking decline appears in October and November, with some recovery in December.

Charts III and IV show the ratio of daily average sorties to strength during 1943. The curves are on a remarkably low level, with a maximum weekly ratio for all types of aircraft of 22 percent and a maximum monthly ratio of 17 percent, in April. For fighters the proportion of aircraft used per day was somewhat higher; the maximum weekly average was 30 percent, and the

1. This week included the Schweinfurt-Regensburg attack of 17 August.

CHART I

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WESTERN FRONT

G.A.F. AVERAGE DAILY SORTIES (WEEKLY), 1943

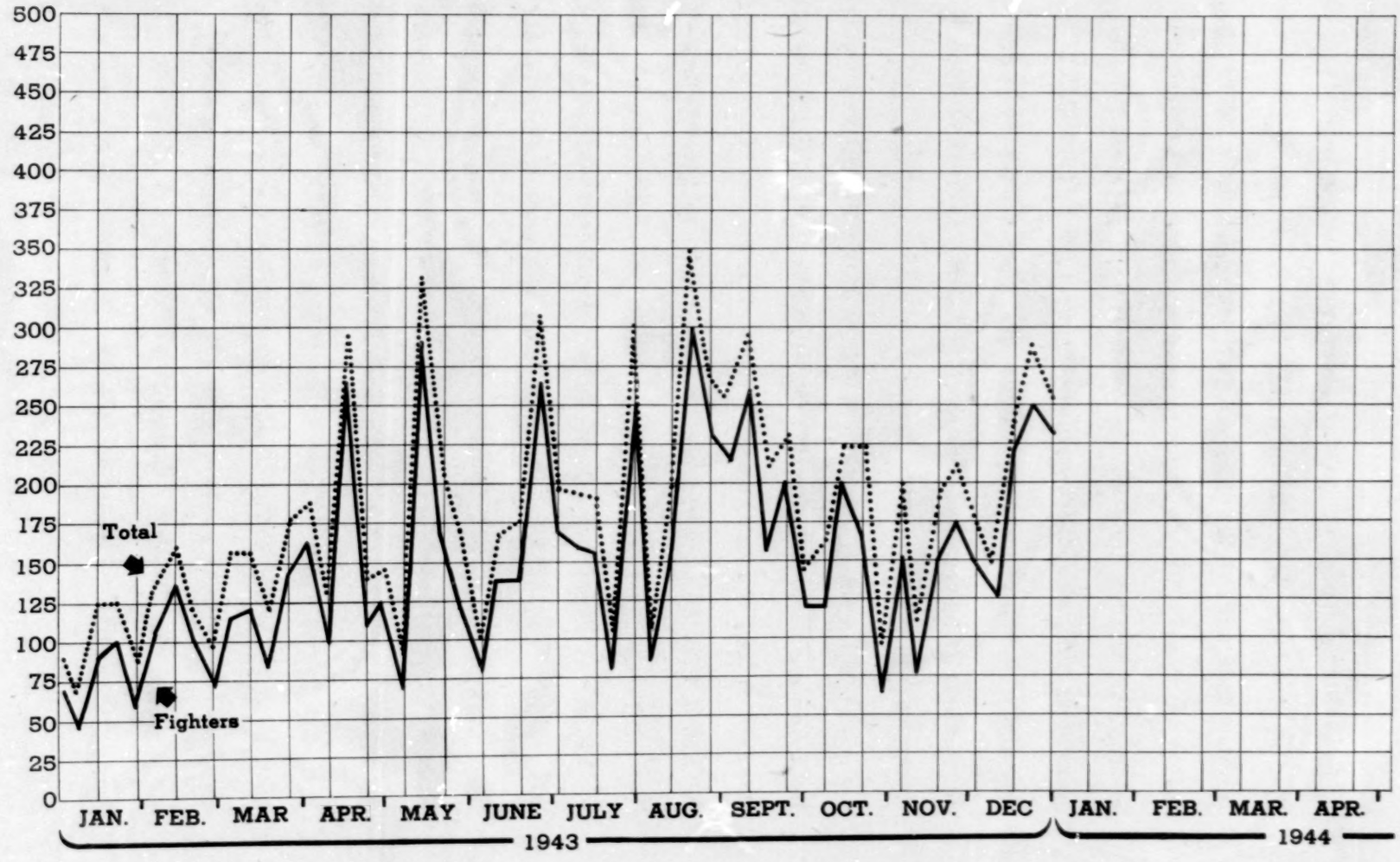

CHART II

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WESTERN FRONT

G.A.F. AVERAGE DAILY SORTIES (MONTHLY), 1943

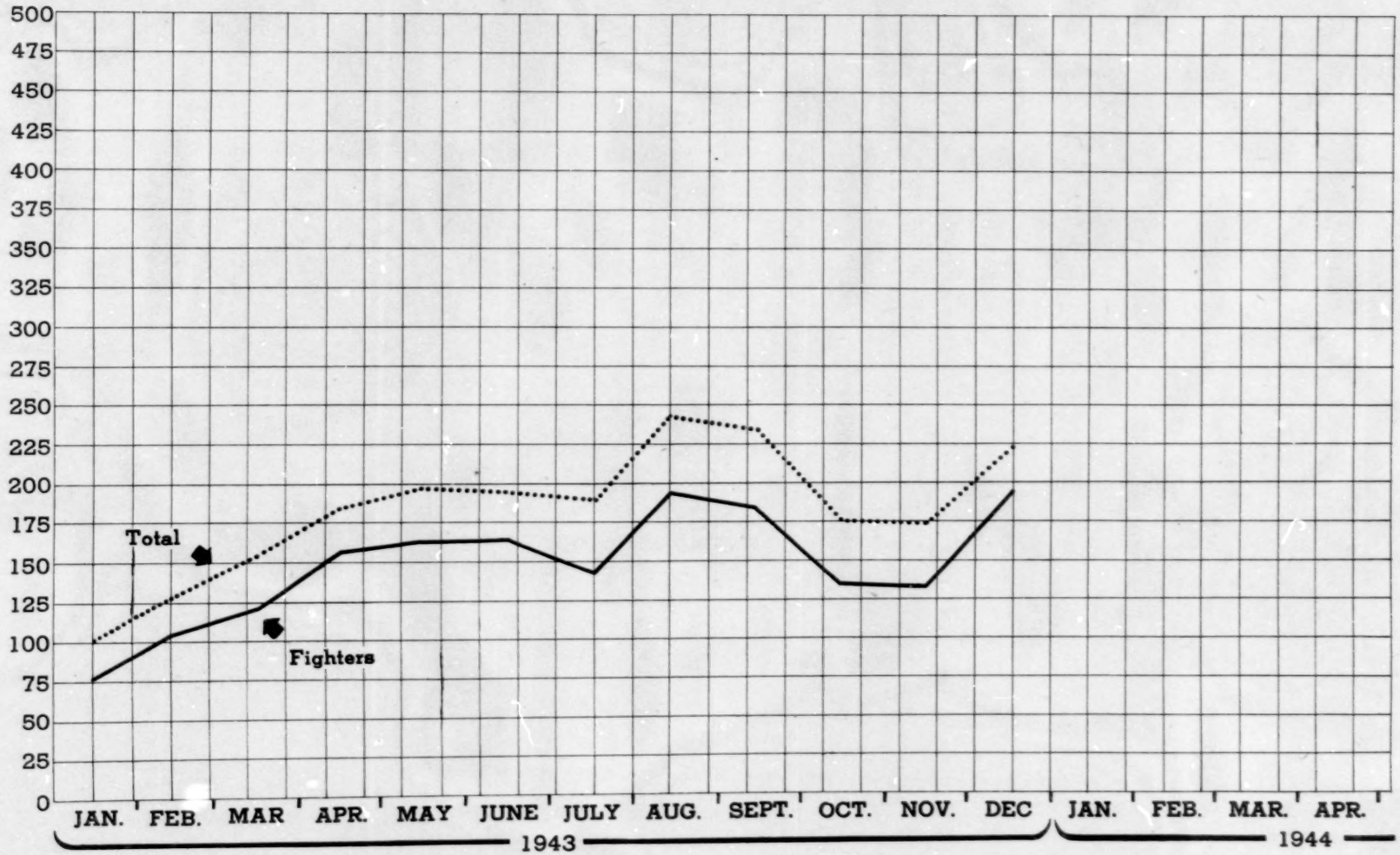

CHART III

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WESTERN FRONT G.A.F. DAILY SORTIES AS PERCENTAGE OF I.E. STRENGTH (WEEKLY), 1943

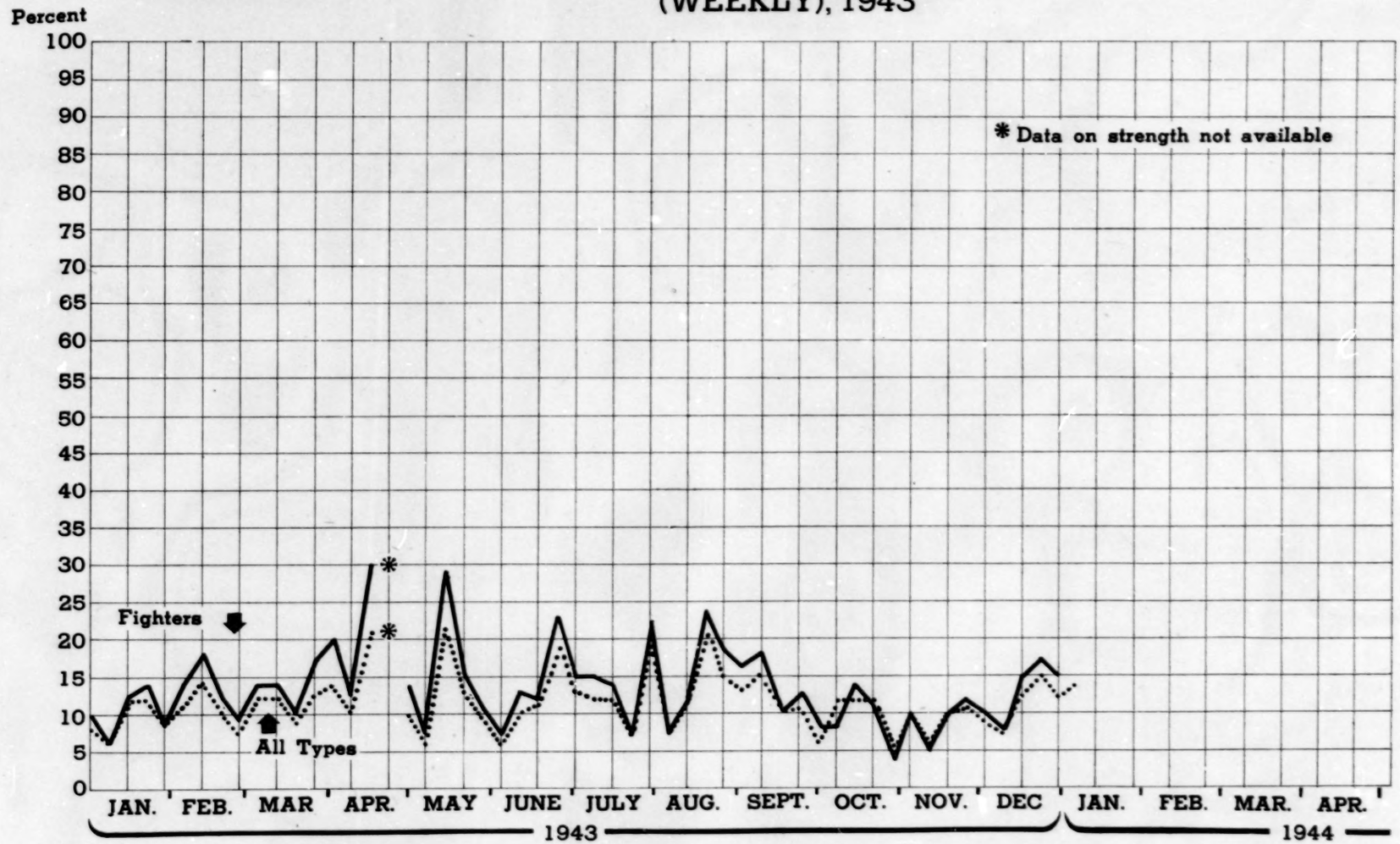

CHART IV

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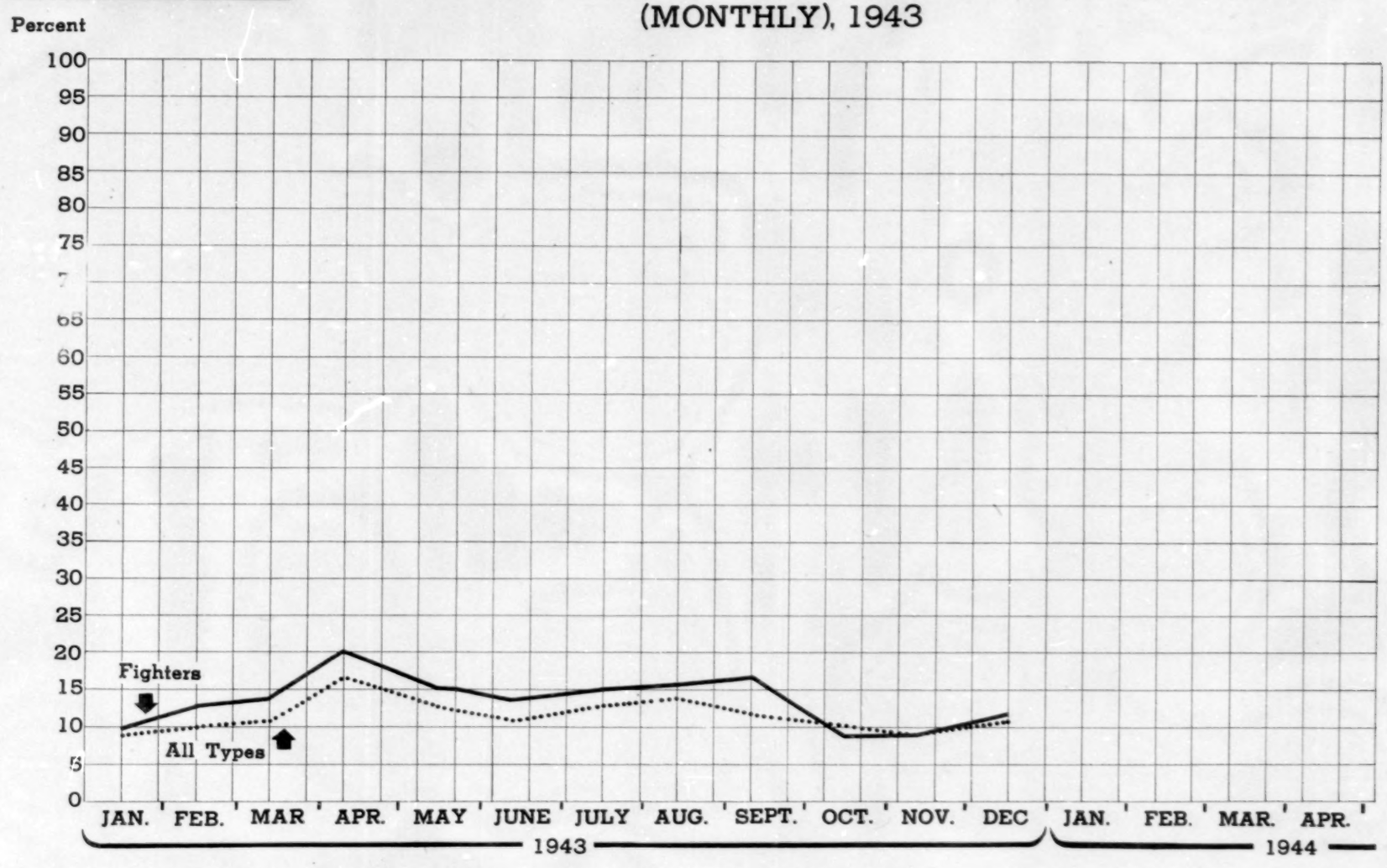
WESTERN FRONT

G.A.F. DAILY SORTIES AS PERCENTAGE OF I.E. STRENGTH (MONTHLY), 1943



maximum monthly average 20 percent, again in April. Intensity of use dropped off steadily during all of the remainder of the year, as bombing of aircraft factories beginning in July necessitated further economies, if strength were to be maintained or increased to meet the increased future requirements.

The low ratio of fighter sorties to strength on the Western Front is explained largely by the type of operations, where fighters are used almost exclusively in defense against strategic bombing, and are therefore used only sporadically. Because of the wide area to be defended, no given raid can call forth the defensive efforts of all of the fighter force, thus reducing still further the average activity rate. The great importance attached to defense against strategic bombing has led the Germans to concentrate the bulk of their fighters in the West, in order to offer the maximum opposition; this, of course, lowers the average activity rate for the whole air force. The low rate of use of bombers on the Western Front is not, however, due to the nature of the operations. In contrast to defensive fighters, whose activity is dependent on Allied activity, and whose disposition must be such as to be ready to meet attack wherever it is directed, bomber activity and disposition are within German control. The extremely low level of bomber activity, therefore, must be explained in terms of poor serviceability of planes, shortage of crews, and policies of conservation. There can be no question that the bomber force in the West has not been fully utilized in 1943.

Weekly CAF fighter sorties exhibit a good correlation with weekly Allied bomber sorties, as is demonstrated by Chart V, which shows the two series. The fact that the relationship between the two curves is not perfect is explained by the fact that the depth of penetration of Allied raids into enemy territory as well as the number of Allied sorties determines the opposition encountered, while the chart shows only the absolute number of Allied bomber sorties. Other factors distorting the relationship include the fact that sweeps by Allied fighters at times provoke additional defensive reaction, and the fact that the usual ratio of offensive to defensive sorties differs as among night fighters and night bombers, day fighters and day heavy bombers, and day fighters and day medium bombers. While the composition of the Allied attack is not the same in any two periods.

One very important fact shown by Chart V is the widening spread between the two curves in 1943, which indicates that German defensive-fighter sorties failed to increase as rapidly as defensive requirements. This widening spread is the indication and measure of the German policy of conservation in 1943. German utilization of fighter strength was low, and could have been increased. Instead, German fighter-sorties declined in the face both of growing German strength and rising Allied attacks. This conservation, however, was definitely a selective conservation - full effort has at all times been thrown against deep penetration to vital German targets.

CHART V

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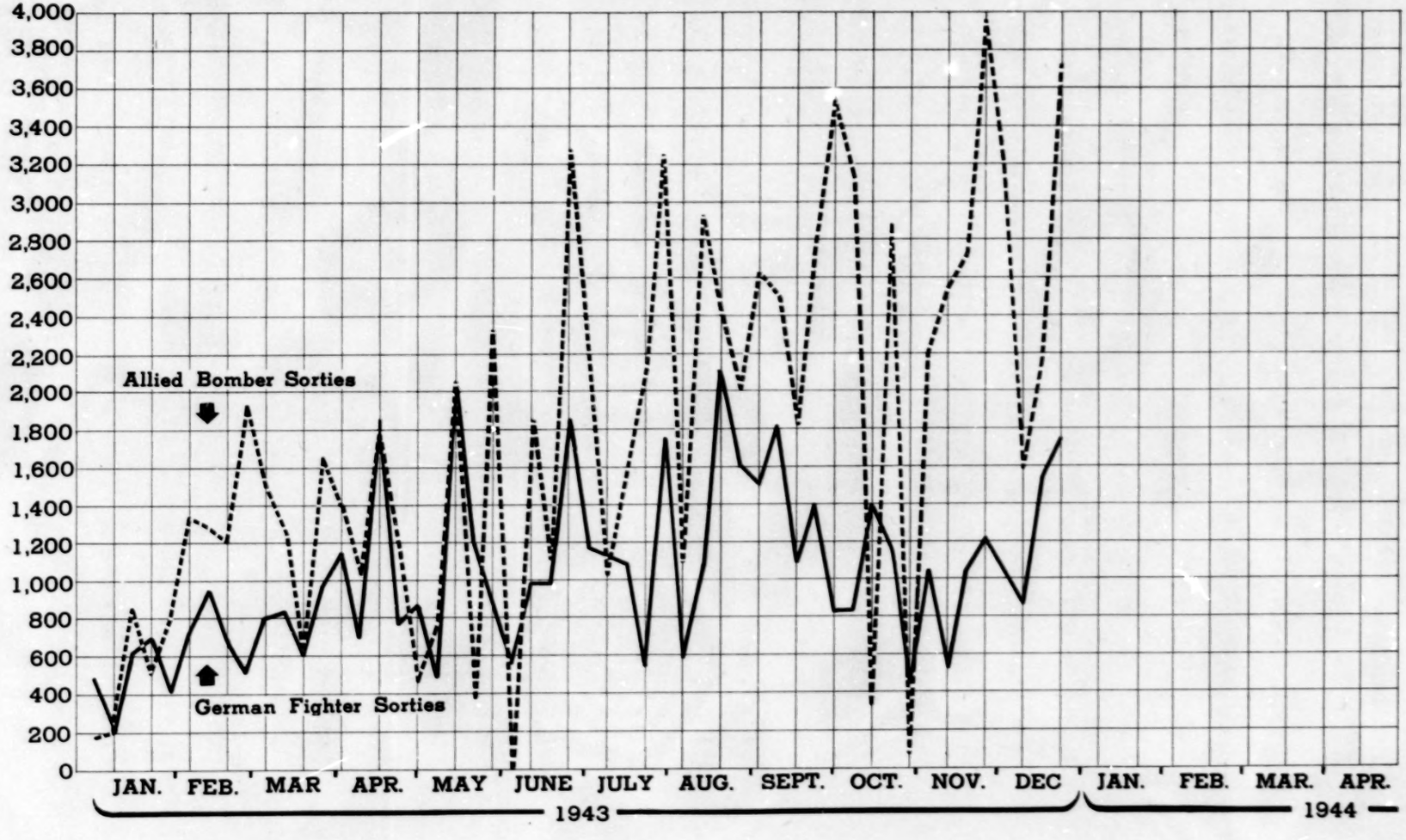
WESTERN FRONT

GERMAN FIGHTER SORTIES vs ALLIED BOMBER SORTIES (WEEKLY), 1943



A factor which in part explains the growing disparity between the trend of German fighter and Allied bomber sorties is the increasing size of Allied bomber formations. Allied sorties have grown not by an increase in the number of missions per month, but by an increase in the number of bombers per mission. It has at all times been German policy to throw all possible strength against deep Allied penetrations, and if the number of bombers per mission increases faster than German strength, as it has, German fighter sorties will obviously fail to rise in proportion to Allied bomber sorties. This does not, however, constitute the sole explanation for the declining ratio, which is in considerable measure a result of policies of conservation - an increasing reluctance to oppose shallow Allied missions, and to offer combat for combat's sake. A factor contributing to this increasing reluctance has been the expanding degree of fighter escort received by Allied daylight bombers in 1943. By November, fighter escort was provided even over the target area. As a result, the hazards of breaking up a bomber formation are considerably increased, and, in order to reduce losses, most fighter attacks on daylight bombers take place during lapses in the fighter escort.

A comparison of German wastage to German strength on the Western Front reveals interesting trends, but these must be interpreted with great caution in assessing the significance of scale

of effort.[1] The ratios of wastage to strength for the principal aircraft types are shown in Chart VI. Single-engine fighter wastage declined in relation to strength during most of the year. A peak ratio of 60 percent for single-engine fighters was reached in May 1943, followed by a continuous decline to 27 percent in October and November. Twin-engine fighter wastage, on the other hand, increased steadily from 12 percent in February to about 20 percent from August through November, while bomber wastage increased in even more striking fashion. If the data can be trusted, the figures seem to confirm the more conservative use of single-engine fighters in the latter part of the year, in response to the declining production and prospective increased requirements.[2]

B. The Mediterranean Front

GAF conservation in the Mediterranean in 1943 took the form of limiting the disposition as well as the intensity of use of planes. While the number of sorties per plane of IE does not appear to be so high as on the Eastern Front, it is considerably higher than on the Western Front. The fact that the actual strength of squadrons and their serviceability was much lower in the Mediterranean than in the West makes this higher ratio even

1. Caution must be exercised because the wastage figures are even more arbitrary than the strength or sortie estimates. British Air Ministry wastage estimates are derived in part by applying arbitrary ratios of wastage to estimated strength, or sorties, and therefore a change in the relationship of wastage to strength or to sorties may merely reveal a change in the wastage ratios assumed rather than any real trend.
2. Because of the higher level of the wastage curve, it appears to decline more rapidly than the ratio of sorties to strength; actually, the curves decline in almost the same proportion.

CHART VI

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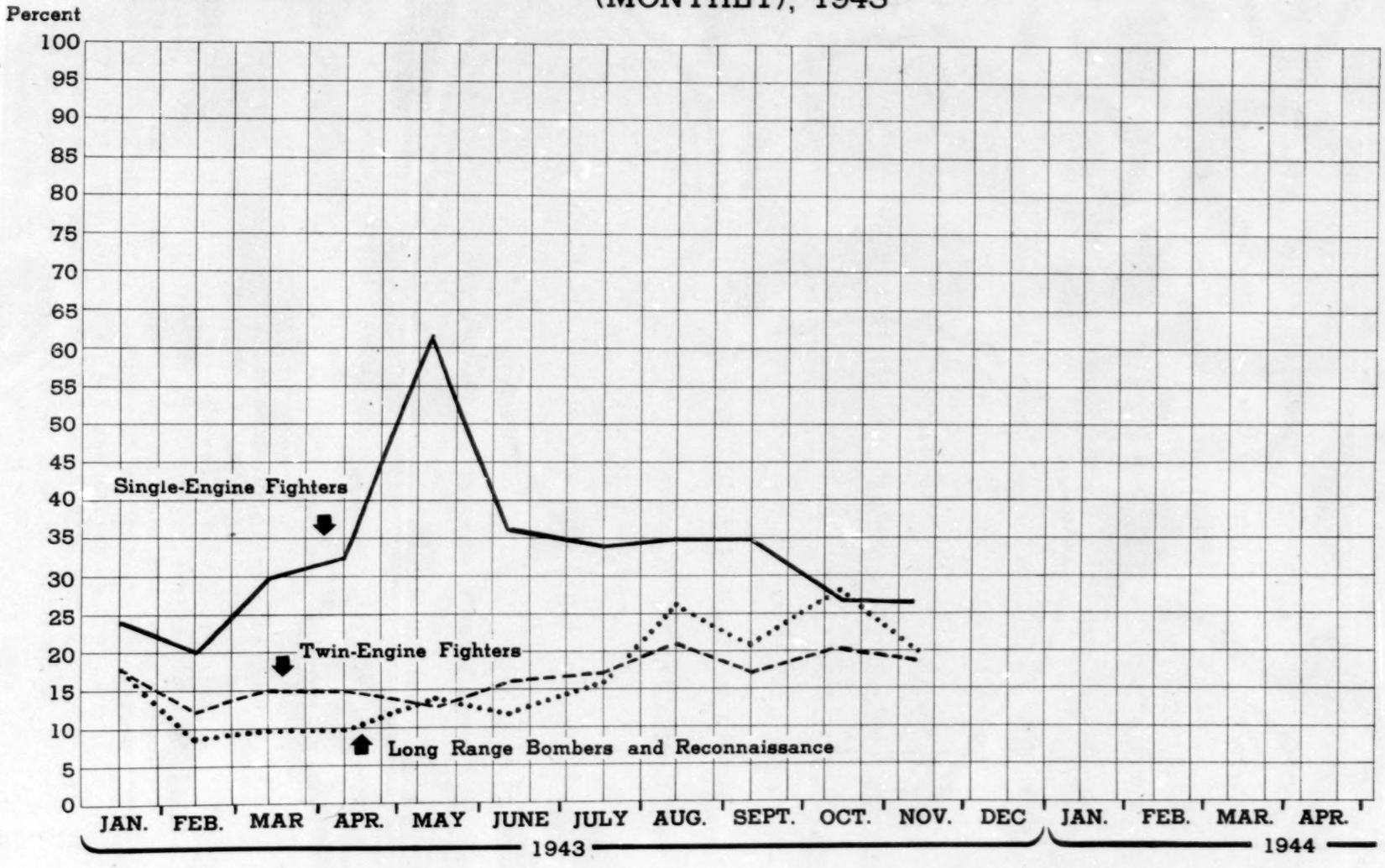
WESTERN FRONT

RATIO OF G.A.F. WASTAGE TO I.E. STRENGTH (MONTHLY), 1943



more significant. This higher utilization arises from the nature of the operations on the Mediterranean Front, where ground operations called for almost daily employment of forces. Effective opposition to Allied land operations was not provided, however, and it is obvious that much larger forces could have been used, had they been available.

The main types of activity carried out in the Western Mediterranean were attacks on Allied shipping, attacks on Allied ground position, defense against Allied sweeps over the battle area, and to some extent defense against strategic bombing. Charts VII and VIII show the number of GAF sorties, all types, and fighters, during 1943 on the Mediterranean Front. Fighter activity was greatest during the two months preceding the fall of Tunisia early in May, when it averaged about 200 daily, with a peak weekly average of 250 per day. During May and June German air operations slackened off. The Allied landing on Sicily on July 10 was resisted by 215 sorties, and by 275 on the following day. No serious opposition was offered to the landing on Italy at Reggio Calabria, but the Salerno battle brought out 150 fighters and 60 bombers operating against Allied shipping. Both in Sicily and in Italy aerial resistance to invasion dropped off sharply after the first few days. Resistance to strategic bombing was considerably less, rarely exceeding 50 sorties per day.

As shown by Chart IX, the average daily effort per week varied from 7 percent to 33 percent of the initial

establishment for all types. As on the Western Front, fighters were used more intensively than other types, with a high of 56 percent at the end of February and a low of 10 percent at the end of December. The monthly ratios (Chart X) show the highest levels of operation during the Tunisian campaign, falling off in May. The lower scale of effort during the summer was partly attributable to the bombing of German airfields and the weakness of squadron strength. The further decline in the last quarter of the year reflects bad weather conditions and the slowing down of the land campaign, as well as conservation policies.

In the Eastern Mediterranean, the GAF with a small force numbering 350 to 450, including some second-line planes, took the offensive and was able to assist in the capture of the Ionian Islands and drive the Allies out of Kos and Leros. Average daily sorties were about 40 percent of the initial establishment for the duration of the German offensive, which began in the latter part of September and ended in the middle of November. This was followed by a sharp drop to an average effort of around 10 percent.[1]

The conservation in the Mediterranean in 1943 was evident in the disposition of strength as well as in its utilization. During the second half of the year particularly, air units were on many occasions not committed to advanced air fields from which

1. On GAF activity in the Mediterranean, see the excellent British Air Ministry paper, "GAF Operations in the Mediterranean, 18 August - 15 October 1943".

CHART VII

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MEDITERRANEAN FRONT — G.A.F. AVERAGE DAILY SORTIES (WEEKLY), 1943

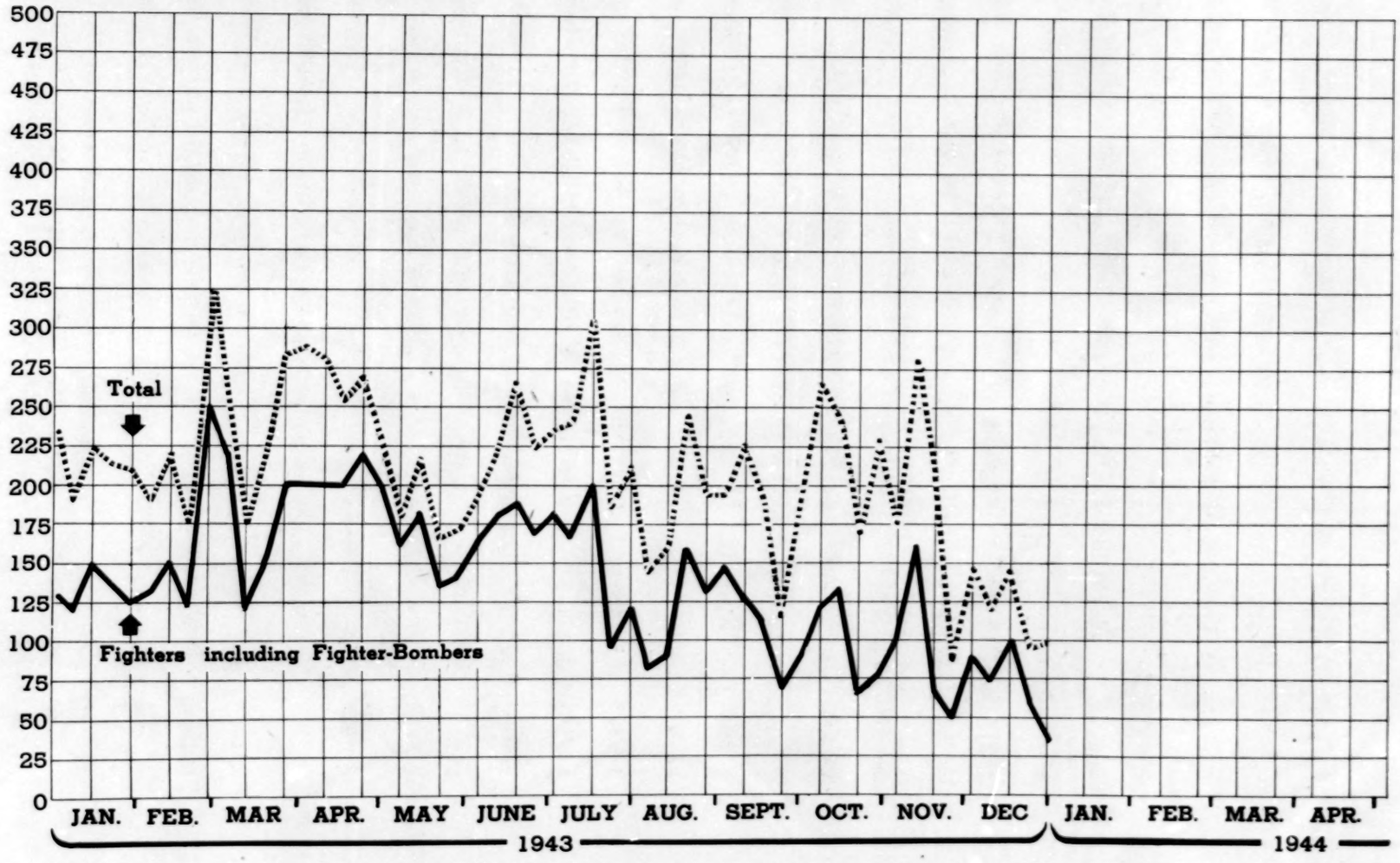

CHART VIII

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MEDITERANEAN FRONT

G.A.F. AVERAGE DAILY SORTIES (MONTHLY), 1943

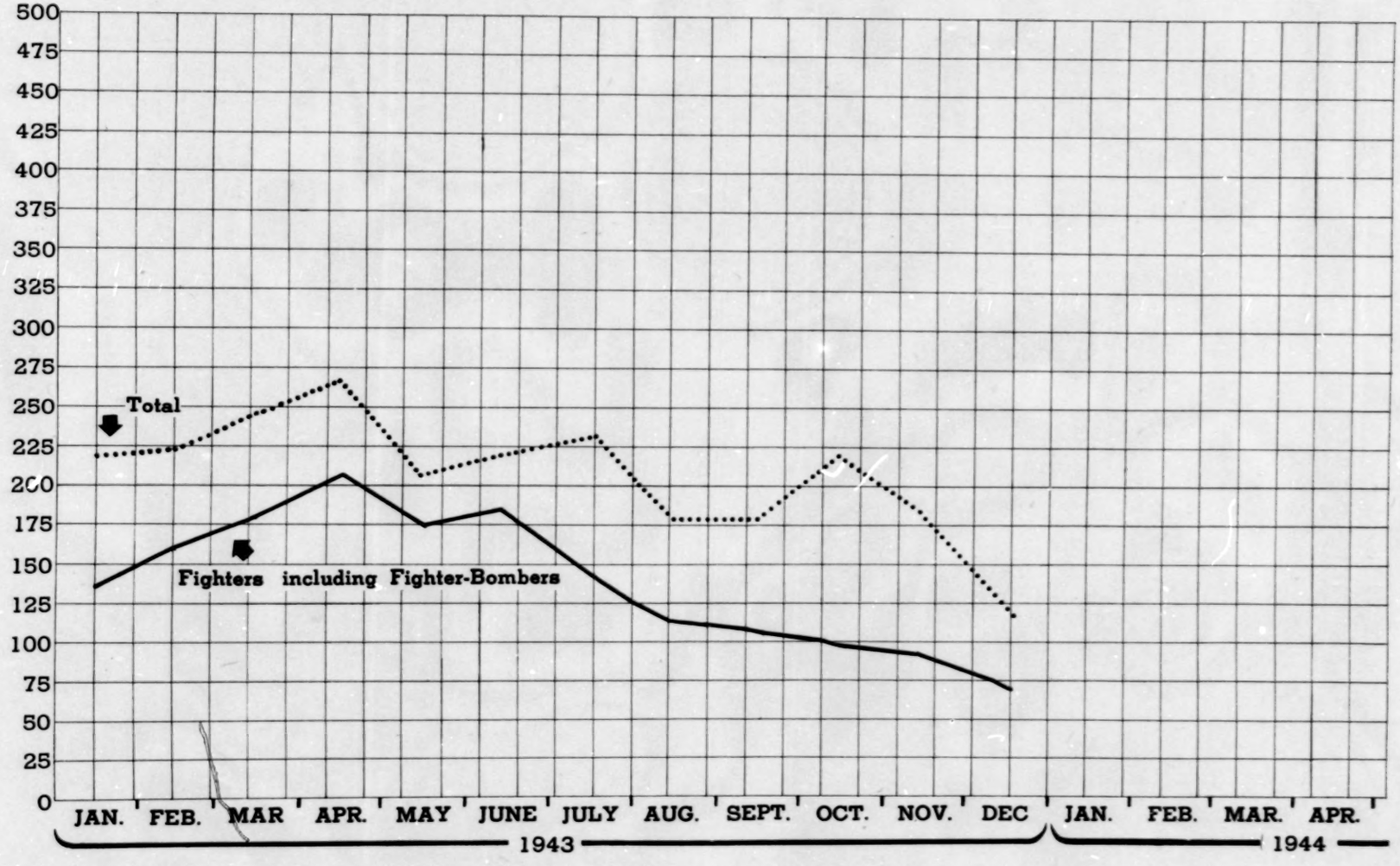

CHART IX

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MEDITERANEAN FRONT

G.A.F. DAILY SORTIES AS PERCENTAGE OF I.E. STRENGTH (WEEKLY), 1943

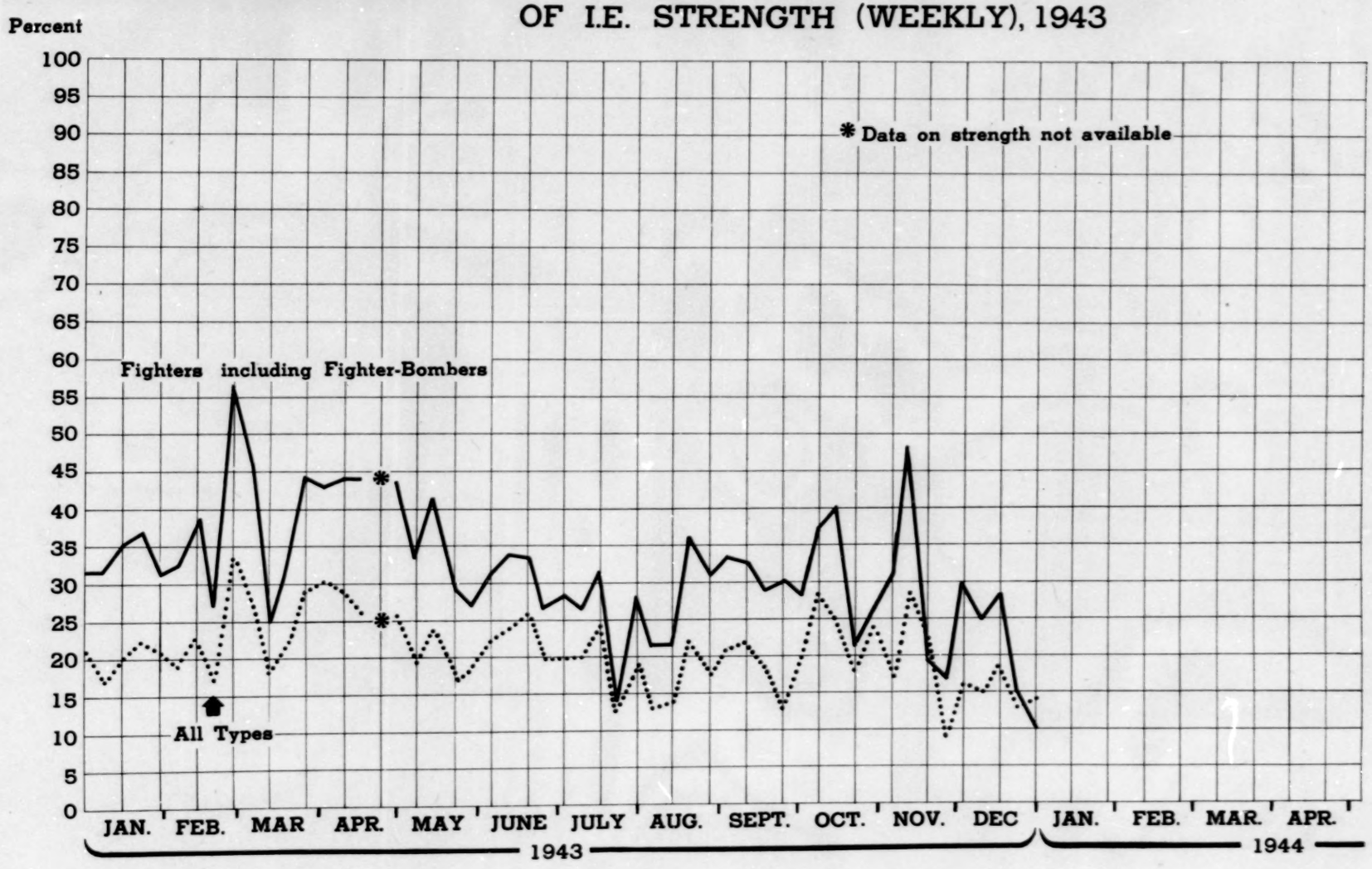

CHART X

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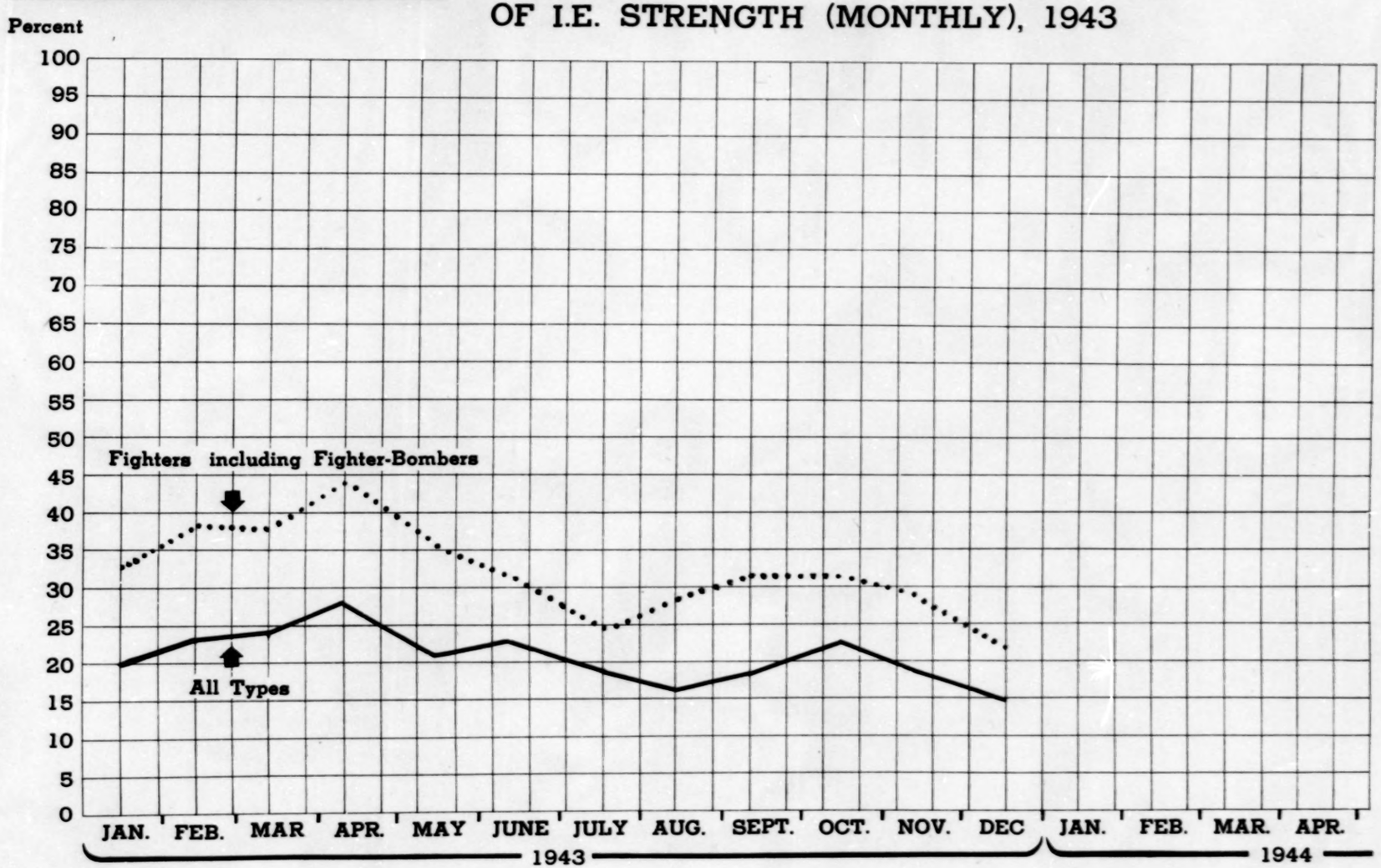
MEDITERRANEAN FRONT

G.A.F. DAILY SORTIES AS PERCENTAGE OF I.E. STRENGTH (MONTHLY), 1943



more effective opposition might have been based, although at greater risk. In the last several months of the year, almost the entire Mediterranean bomber force was withdrawn to Central Germany, where, although fully-equipped, it remained unallocated. Throughout the year, the failure of the GAF effectively to attack Allied Mediterranean shipping, except sporadically, was notable. The concentrations of shipping prior to amphibious operations were not effectively bombed, although this may have been caused in part by poor reconnaissance and intelligence.

The ratios of GAF wastage to strength in the Mediterranean in 1943 are shown in Chart XI. Single-engine fighter wastage was far higher in relation to strength in the Mediterranean than on the Western Front, because of the more intensive use.[1] Three peak levels of wastage in relation to strength are noted - in April, when the Tunisian fighting reached its climax; in July, during the Battle for Sicily; and in September, when the Allies landed at Salerno. Twin-engine fighter and bomber wastage also reached peak levels in July and September. The July peak is in part accounted for by the very large number of planes captured on the ground. The decline in the ratio of single-engine fighter wastage in the latter half of the year reflects the declining ratio of sorties to strength, noted above, but is more pronounced than the decline in sorties.

1. It should also be noted that the Mediterranean ratio of wastage to strength exceeds the Western Front ratio by more than does the corresponding ratio of sorties to strength - i.e., not only was each plane used more frequently in the Mediterranean, but also there was a higher loss rate per sortie, than in the West.

C. The Russian Front

On the Russian Front the Luftwaffe operates primarily in support of the Army. Not a great deal is known about the intensity of air operations in this theater. However, during the short-lived German offensive in July, an average of 800 to 1,000 sorties was attained daily during the first week and 700 to 800 in the following week.

With an initial establishment on the Eastern Front of roughly 2,000 aircraft, it is estimated that 700 to 1,000 were destroyed or damaged per month during 1943. This represents a high rate of activity, unless there is an abnormally high rate of loss per sortie, and there is no reason to believe that to be the case. In fact, the Air Ministry has estimated that the loss-rate per sortie on the Russian Front is only half that on the Mediterranean and Western Fronts. Both the actual wastage and rate of wastage are higher on the Russian Front than on the Western or Mediterranean, thus implying a utilization of strength several times as high as on the other fronts.

Chart XII shows the ratio of wastage to strength for principal aircraft types on the Eastern Front. Aside from single-engine fighters, where a higher ratio prevailed in the Mediterranean, the loss rates in the East are higher than on the other fronts. There is no discernable trend in the ratio of wastage to strength over the course of the year, other than a decline, which may be seasonal, in the last quarter.

CHART XI

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MEDITERRANEAN FRONT

RATIO OF G.A.F. WASTAGE TO I.E. STRENGTH (MONTHLY), 1943

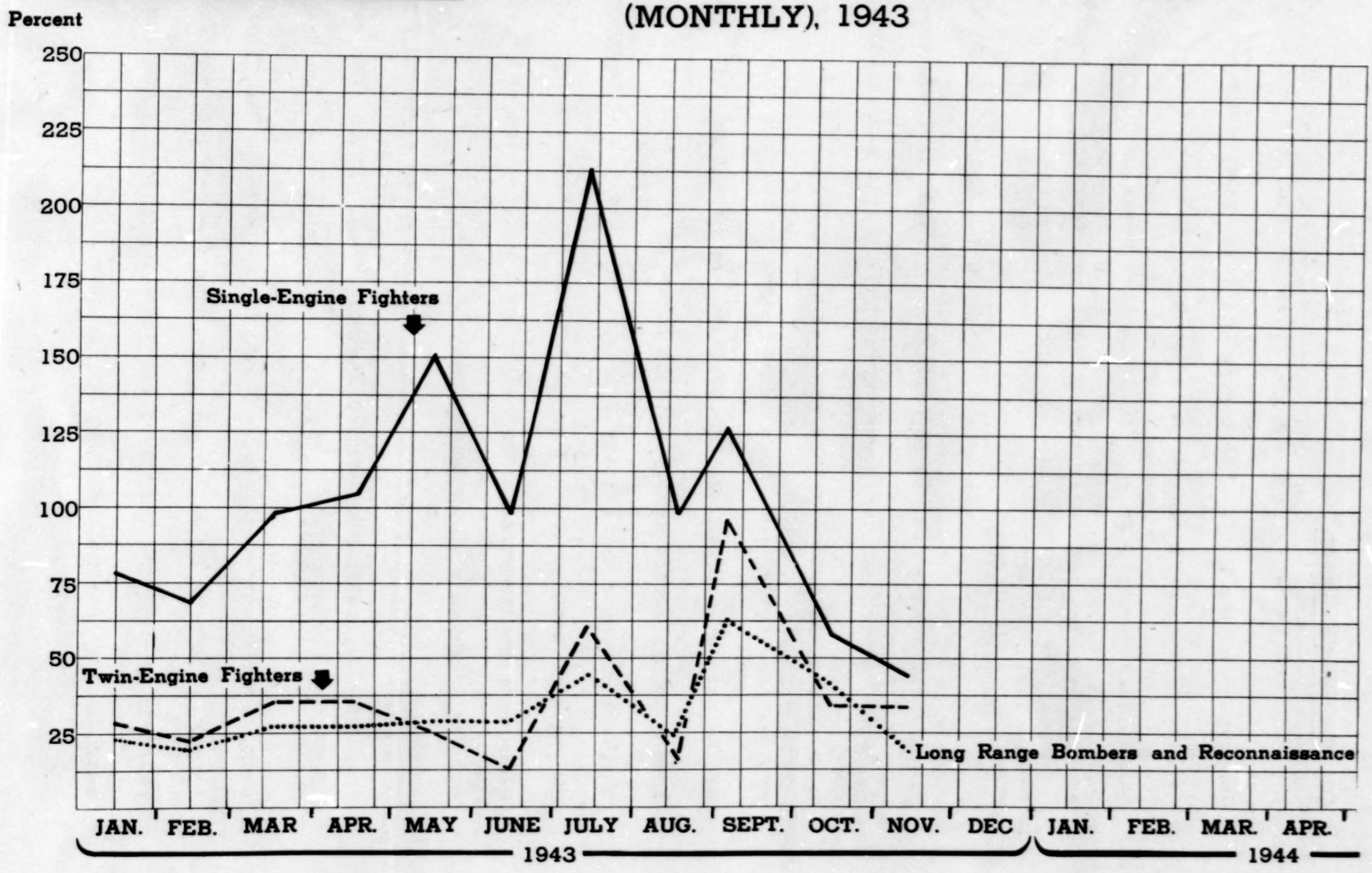

CHART XII

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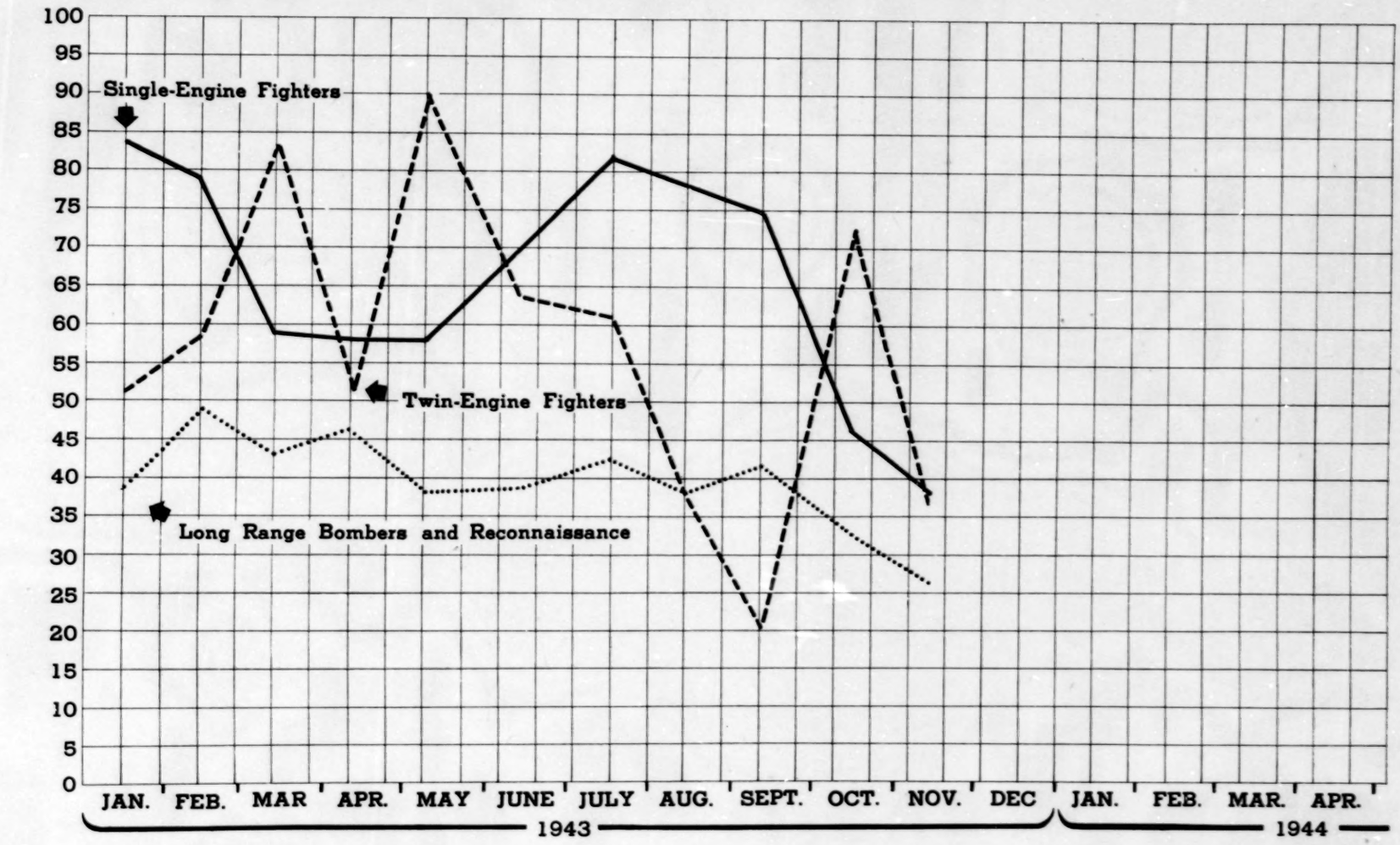
RUSSIAN FRONT

RATIO OF G.A.F. WASTAGE TO I.E. STRENGTH (MONTHLY), 1943



D. Comparison Among Fronts

The following table summarizes the comparative situation as to intensity of use in 1943 among the various fronts and plane types:

Table 1. AVERAGE INTENSITY OF GERMAN AIR FORCE SCALE OF EFFORT IN 1943, BY FRONTS, PRINCIPAL AIRCRAFT TYPES

Type of Aircraft	Ratio of average daily sorties to IE strength		Ratio of monthly wastage to IE strength		
	Western Front	Mediterranean Front	Western Front	Mediterranean Front	Eastern Front
Long range bombers	5 %	9 %	16 %[a]	30 %[a]	40 %[a]
Dive bombers	---	---	----	23	34
Single-engine fighters	12	32[b]	33	101	65
Twin-engine fighters			17	33	54
All types	11	23	22	45	39

a. Includes bomber reconnaissance.
b. Also includes fighter bombers.